CLAIMS

What is claimed is:

1. A method of reducing offsets of a transceiver comprising:

measuring receiver amplitude and phase mismatches of receiver radio-frequency (RF) circuitry by performing a fast Fourier transform (FFT) on a receiver calibration signal;

applying receiver amplitude and phase offsets to substantially offset the receiver mismatches;

applying a transmitter calibration signal; and

measuring transmitter amplitude and phase mismatches of transmitter RF circuitry by performing an FFT on the transmitter calibration signal.

2. The method of claim 1 further comprising prior to applying the transmitter calibration signal, coupling an output of transmitter RF circuitry to an input of the receiver RF circuitry, and

wherein the applying the receiver amplitude and phase offsets is performed concurrently with the applying the transmitter calibration signal to measure the transmitter amplitude and phase mismatches.

3. The method of claim 2 wherein measuring the receiver amplitude and phase mismatches comprises measuring an image component of the receiver calibration signal produced by the receiver RF circuitry after performing an FFT on the receiver calibration signal at an output of the receiver RF circuitry, and

wherein measuring the transmitter amplitude and phase mismatches comprises measuring an image component of the transmitter calibration signal produced by the transmitter RF circuitry after performing an FFT on the transmitter calibration signal at the output of the receiver RF circuitry.

4. The method of claim 3 further comprising:

generating the receiver amplitude and phase offsets based on the measured receiver amplitude and phase mismatches; and

generating transmitter amplitude and phase offsets based on the transmitter amplitude and phase mismatches.

5. The method of claim 4 wherein the transmitter amplitude and phase offsets are applied to transmit frequency-domain signals in a signal path before performing an inverse FFT (IFFT) on transmitter signals provided to the transmitter RF circuitry, and

wherein the receiver amplitude and phase offsets are applied to receiver frequency-domain signals in a signal path after performing an FFT on signals provided by the receiver RF circuitry.

6. The method of claim 4 wherein the transmitter amplitude and phase offsets are applied to transmit time-domain signals in a signal path after performing an inverse FFT (IFFT) on transmitter signals provided to the transmitter RF circuitry, and

wherein the receiver amplitude and phase offsets are applied to receiver time-domain signals in a signal path before performing an FFT on signals provided by the receiver RF circuitry.

7. The method of claim 1 further comprising coupling a limiter between an output of the transmitter RF circuitry and an input of receiver RF circuitry, the limiter to generate a receiver-transmitter calibration signal based on an output RF signal of the transmitter RF circuitry, the receiver-transmitter calibration signal having a non-image component, an image component and a main component,

wherein the transmitter amplitude and phase mismatches are measured by performing the FFT on the receiver-transmitter calibration signal based on the non-image component, the FFT to separate the image component, the non-image component and the main component.

8. The method of claim 7 further comprising:

generating the transmitter amplitude and phase offsets based on the non-image component;

applying the transmitter amplitude and phase offsets to substantially reduce the non-image component and an image component due to the transmitter RF circuitry; and

determining the receiver amplitude and phase offsets while applying the transmitter amplitude and phase offsets.

9. The method of claim 1 further comprising applying the receiver calibration signal to an input of receiver RF circuitry, and

wherein the receiver calibration signal is applied either prior to or concurrently with the measuring the receiver amplitude and phase mismatches.

10. The method of claim 9 wherein applying the receiver calibration signal comprises applying a substantially pure single tone sinusoid radio frequency (RF) receiver calibration signal to the input of the receiver RF circuitry.

11. The method of claim 10 wherein the receiver calibration signal is generated by calibration voltage controlled oscillator and synthesizer circuitry.

12. The method of claim 10 wherein the receiver calibration signal is generated by a replica of a voltage controlled oscillator of the transmitter RF circuitry with a frequency offset.

13. The method of claim 10 wherein the receiver calibration signal is generated by a delay-locked loop combining phases of a voltage controlled oscillator of the transmitter RF circuitry.

14. The method of claim 1 further comprising applying the transmitter calibration signal comprising a single tone complex sinusoid generated by a subcarrier modulator, and

wherein the method further comprises injection locking a voltage controlled oscillator at an output of the transmitter RF circuitry with the transmitter calibration signal to generate a low-image signal at the output of the transmitter RF circuitry.

15. The method of claim 3 wherein the method is performed by a first communication station, and wherein after generating both the transmitter and receiver amplitude and phase offsets, the method further comprises:

applying the transmitter amplitude and phase offsets to a transmit signal comprising transmit frequency-domain signals before performing an IFFT on the transmit frequency-domain signals;

RF modulating and transmitting the transmit signal to a second communication station;

receiving and RF demodulating a received signal received from the second communication station; and

applying the receiver amplitude and phase offsets to receive frequency-domain signals comprising the received signal after performing an FFT on the received signal.

16. The method of claim 1 wherein the transceiver is a multicarrier transceiver which communicates a multicarrier signal comprising a plurality of symbol-modulated subcarriers, and

wherein the measuring the receiver mismatches, the applying the receiver offsets, the applying the transmitter calibration signal, and the measuring the transmitter mismatches are performed for subcarriers of the plurality.

17. A transceiver comprising:

calibration circuitry to measure receiver amplitude and phase mismatches of receiver RF circuitry from a fast Fourier transform (FFT) on a receiver calibration signal; and

receiver offset correction circuitry to apply receiver amplitude and phase offsets to substantially offset the receiver mismatches,

wherein the calibration circuitry measures transmitter amplitude and phase mismatches of transmitter RF circuitry from an FFT on a transmitter calibration signal.

18. The transceiver of claim 17 wherein an output of the transmitter RF circuitry is coupled to an input of the receiver RF circuitry prior to applying the transmitter calibration signal, and

wherein the receiver offset correction circuitry applies the receiver amplitude and phase offsets concurrently with the transmitter calibration signal to allow the calibration circuitry to measure the transmitter amplitude and phase mismatches.

19. The transceiver of claim 18 further comprising FFT circuitry, wherein the calibration circuitry measures an image component of the receiver calibration signal produced by the receiver RF circuitry after the FFT circuitry performs an FFT on the receiver calibration signal at an output of the receiver RF circuitry, and

wherein the calibration circuitry measures an image component of the transmitter calibration signal produced by the transmitter RF circuitry after the FFT circuitry performs an FFT on the transmitter calibration signal at the output of the receiver RF circuitry.

20. The transceiver of claim 19 wherein the calibration circuitry generates the receiver amplitude and phase offsets based on the measured receiver amplitude and phase mismatches, and

the calibration circuitry generates the transmitter amplitude and phase offsets based on the transmitter amplitude and phase mismatches.

21. The transceiver of claim 20 further comprising inverse FFT (IFFT) circuitry, and

wherein the transmitter offset correction circuitry applies the transmitter amplitude and phase offsets to transmitter frequency-domain signals in a signal path before the IFFT circuitry performs an IFFT on transmit signals, and

wherein the receiver offset correction circuitry applies the receiver amplitude and phase offsets to receiver frequency-domain signals in a signal path after the FFT circuitry performs an FFT on signals from the receiver RF circuitry.

22. The transceiver of claim 20 further comprising inverse FFT (IFFT) circuitry, and

wherein the transmitter offset correction circuitry applies the transmitter amplitude and phase offsets to transmitter time-domain signals in a signal path after the IFFT circuitry performs an IFFT on the transmitter signals, and

wherein the receiver offset correction circuitry applies the receiver amplitude and phase offsets to receiver time-domain signals in a signal path before the FFT circuitry performs an FFT on signals from the receiver RF circuitry.

23. The transceiver of claim 17 further comprising inverse FFT (IFFT) circuitry, FFT circuitry, and a limiter coupled between an output of the transmitter RF circuitry and an input of the receiver RF circuitry, the limiter to generate a receiver-transmitter calibration signal based on an output RF signal of the transmitter RF circuitry, the receiver-transmitter calibration signal having a non-image component, an image component and a main component,

wherein the calibration circuitry measures the transmitter amplitude and phase mismatches based on the non-image component after the FFT circuitry performs the FFT on the receiver-transmitter calibration signal to separate the image, non-image and main components.

24. The transceiver of claim 23 wherein the calibration circuitry generates the transmitter amplitude and phase offsets based on the non-image component,

wherein the transmitter offset correction circuitry applies the transmitter amplitude and phase offsets to substantially reduce the non-image component and an image component due to the transmitter RF circuitry, and

wherein the calibration circuitry determines the receiver amplitude and phase offsets while applying the transmitter amplitude and phase offsets. .

25. The transceiver of claim 17 wherein a calibration synthesizer applies the receiver calibration signal to an input of the receiver RF circuitry, and

wherein the receive calibration signal is applied either prior to or concurrently with the calibration circuitry to measure the receiver amplitude and phase mismatches.

26. The transceiver of claim 25 wherein the receiver calibration signal comprises a substantially pure single tone sinusoid radio frequency (RF) receiver calibration signal.

27. The transceiver of claim 26 further comprising a calibration voltage controlled oscillator and synthesizer circuitry to generate the receiver calibration signal.

28. The transceiver of claim 26 further comprising a voltage controlled oscillator to generate the receiver calibration signal, the voltage controlled oscillator being a replica of a voltage controlled oscillator of the transmitter RF circuitry to generate the receiver calibration signal with a frequency offset.

29. The transceiver of claim 26 further comprising a delay-locked loop to generate the receiver calibration signal by combining phases a voltage controlled oscillator of the transmitter RF circuitry,

30. The transceiver of claim 25 wherein the transmitter calibration signal comprises a single tone complex sinusoid generated by a subcarrier modulator, and

wherein a voltage controlled oscillator is injection locked with signals at an output of the transmitter RF circuitry generated by the transmitter RF circuitry in response to the transmitter calibration signal, the voltage controlled oscillator to generate a low-image signal at the output of the transmitter RF circuitry.

31. The transceiver of claim 17 wherein the transmitter and receiver RF circuitry communicate multicarrier signals comprising a plurality of symbol-modulated subcarriers, and

wherein the calibration circuitry measures the receiver and transmitter mismatches for at least one subcarrier of the plurality, and

wherein the transmitter offset correction circuitry applies transmitter offsets and the receiver offset correction circuitry applies receiver offsets for the subcarriers of the plurality.

32. A multicarrier receiver comprising:

receiver RF circuitry;

fast Fourier transform (FFT) circuitry to perform FFTs on output signals from the receiver RF circuitry;

calibration circuitry to measure amplitude and phase mismatches of the receiver RF circuitry based on outputs of the FFT circuitry; and

receiver offset correction circuitry to apply receiver amplitude and phase offsets to the receiver output signals to substantially offset the measured amplitude and phase mismatches in the receiver RF circuitry.

33. The receiver of claim 32 further comprising a calibration synthesizer to apply a receiver calibration signal to an input of the receiver RF circuitry for the calibration circuitry to measure the amplitude and phase mismatches of the receiver RF circuitry.

34. The receiver of claim 33 wherein the receiver offset correction circuitry applies the receiver amplitude and phase offsets in a frequency domain in a signal path after the FFT circuitry.

35. The receiver of claim 33 wherein the receiver offset correction circuitry applies the receiver amplitude and phase offsets in a time-domain in a signal path before the FFT circuitry.

36. A multicarrier transmitter comprising:

transmitter RF circuitry;

inverse fast Fourier transform (IFFT) circuitry to perform IFFTs on signals for transmission by the transmitter RF circuitry;

calibration circuitry to measure amplitude and phase mismatches of the transmitter RF circuitry based on outputs of fast Fourier transform (FFT) circuitry; and

transmitter offset correction circuitry to apply transmitter amplitude and phase offsets to transmitter signals to substantially offset the measured amplitude and phase mismatches in the transmitter RF circuitry.

37. The transmitter of claim 36 further comprising a subcarrier modulator, and wherein the calibration circuitry applies a transmitter calibration control signal to the subcarrier modulator, the subcarrier modulator to generate a transmitter calibration signal, and the calibration circuitry to measure the amplitude and phase mismatches of the transmitter RF circuitry based on the transmitter calibration signal.

38. The transmitter of claim 37 wherein the transmitter offset correction circuitry applies the transmitter amplitude and phase offsets in a frequency domain in a signal path before the IFFT circuitry.

39. The transmitter of claim 37 wherein the transmitter offset correction circuitry applies the transmitter amplitude and phase offsets in a time-domain in a signal path after the IFFT circuitry.

40. A system comprising:

a substantially omnidirectional antenna;

a transceiver to communicate signals with the antenna, the transceiver comprising:

calibration circuitry to measure receiver amplitude and phase mismatches of receiver radio-frequency (RF) circuitry from a fast Fourier transform (FFT) on a receiver calibration signal; and

receiver offset correction circuitry to apply receiver amplitude and phase offsets to substantially offset the receiver mismatches,

wherein the calibration circuitry measures transmitter amplitude and phase mismatches of transmitter RF circuitry from an FFT on a transmitter calibration signal.

41. The system of claim 40 wherein an output of the transmitter RF circuitry is coupled to an input of the receiver RF circuitry prior to the calibration synthesizer applying the transmitter calibration signal, and

wherein the receiver offset correction circuitry applies the receiver amplitude and phase offsets concurrently with the transmitter calibration signal to allow the calibration circuitry to measure the transmitter amplitude and phase mismatches.

42. The system of claim 41 wherein the transceiver further comprises FFT circuitry, and

wherein the calibration circuitry measures an image component of the receiver calibration signal produced by the receiver RF circuitry after the FFT circuitry performs an FFT on the receiver calibration signal at an output of the receiver RF circuitry, and

wherein the calibration circuitry measures an image component of the transmitter calibration signal produced by the transmitter RF circuitry after the FFT circuitry performs an FFT on the transmitter calibration signal at the output of the receiver RF circuitry.

43. A machine-readable medium that provides instructions, which when executed by one or more processors, cause the processors to perform operations comprising:

measuring receiver amplitude and phase mismatches of receiver RF circuitry by performing a fast Fourier transform (FFT) on a receiver calibration signal;

applying receiver amplitude and phase offsets to substantially offset the receiver mismatches;

applying a transmitter calibration signal; and

measuring transmitter amplitude and phase mismatches of transmitter RF circuitry by performing an FFT on the transmitter calibration signal.

44. The machine-readable medium of claim 43 wherein the instructions, when further executed by one or more of the processors cause the processors to perform operations further comprising, prior to applying the transmitter calibration signal, coupling an output of the transmitter RF circuitry to an input of receiver RF circuitry, and

wherein the applying the receiver amplitude and phase offsets is performed concurrently with the applying the transmitter calibration signal to measure the transmitter amplitude and phase mismatches.

45. The machine-readable medium of claim 44 wherein the instructions, when further executed by one or more of the processors cause the processors to perform operations further comprising:

wherein measuring the receiver amplitude and phase mismatches comprises measuring an image component of the receiver calibration signal produced by the receiver RF circuitry after performing an FFT on the receiver calibration signal at an output of the receiver RF circuitry, and

wherein measuring the transmitter amplitude and phase mismatches comprises measuring an image component of the transmitter calibration signal produced by the transmitter RF circuitry after performing an FFT on the transmitter calibration signal at the output of the receiver RF circuitry.